

The Role of “Etiquette” in an Automated Medication Reminder

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Abstract

This paper describes a model of politeness between intentional agents developed from sociolinguistic observations of human-human interactions (Brown and Levinson, 1987) and suggests a method for applying it to human-machine interactions. Applications in the context of a medication reminder system are presented including data which suggest that the Brown and Levinson model provides good predictions for how “polite” alternate reminding utterances will be perceived when delivered by a machine. Additional data from a field test of one such reminding system are presented which indicate that “politeness”, and the etiquette behaviors which achieve various levels of politeness, are important to elders—though not that maximal politeness behaviors are either expected, desired or, perhaps, productive. Further, future applications of the Brown and Levinson model in military training are also discussed.

Introduction

Monitoring and issuing reminders for compliance with a medication or rehabilitation regime is one of the most useful roles that aiding systems can perform (Haigh and Yanco, 2002; Bickmore, 2003). Medication compliance is of substantial concern in situations ranging from ensuring adherence to simple medication regimes involving antibiotics (so as to avoid producing resistant disease strains), to assisting compliance with complicated schedules of multiple drugs (as is the case in HIV and many forms of cancer treatment), to ensuring the validity of a clinical trial, to assisting compliance from those who may have physical or cognitive ailments, particularly the elderly. But many different kinds of automated reminding systems are possible, ranging from a simple calendar or paper schedule and checklist, through schedule-based automated reminders such as might be provided by a PDA, through recorded messages to avatar-based, interactive reminding systems and on to humans who check in and offer reminders and/or support. In very many cases, particularly among the elderly, patients would prefer the human reminding approach, but there is also emerging evidence (e.g., Bickmore, 2003) that computer-based avatars can achieve at least some of

the flexibility, adaptiveness, and social behaviors that patients are seeking from longer term and/or more sensitive relationships with human reminders.

One thing that humans who offer reminders can do that automated systems cannot generally do, as yet, is to adjust their presentation of reminders to adhere to and perhaps utilize the social interaction expectations of the patients they are reminding. This capability is likely to be particularly important in the offering of reminders since they are, necessarily, an intrusion into the patient’s ongoing activities, as well as potentially threatening evidence of having overlooked an activity that was supposed to be performed, and finally, they may well be requests to perform some activity that will not be pleasant for the patient. For example, initial reminder interactions might well be more formal or “polite”, and contain more detail than subsequent ones where the patient is deeply familiar with both the routine and with the reminding system. Similarly, a human offering reminders would not always deliver the reminder in the same way. When the patient is doing well at following the regime, the human might offer congratulations and encouragement; when the patient is doing poorly, the human reminder might offer a sterner form of urging and/or some additional rationale as to why the regime should be followed. Above all, the human would adjust the form and content of reminders to the individual patient—noting what works and what doesn’t, and trying something different and/or seeking explanations when there is evidence that the current form of reminding is starting to fail.

We have recently been involved in a project which provides the basis for such a dynamic, involved, and socially-adaptive reminder system. Elements of this research come from a “smart home” development effort known as the Independent LifeStyle AssistantTM (I.L.S.A.), as well as a Small Business Innovation Research grant sponsored the DARPA DARWARs project focused on using gaming technologies for militarily-relevant training, which we have recently begun. Below, we will first describe our vision and then describe a rationale for an approach to realizing it based primarily from data collected during the I.L.S.A. project. We will conclude with a brief discussion of the path toward future developments we are taking in the DARPA project and it’s relevance for medication reminding systems.

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Etiquette-Based Reminders

For all the reasons described above, reminding is a socially-charged behavior in human-human interactions. As such, it is perhaps not surprising that we have developed and applied a host of social skills to managing that interaction. These skills, embodied in a set of interaction moves and the expectations and interpretations associated with them, are what we refer to as the etiquette of reminding. For example, a human who apologizes for interrupting the ongoing daily activities of a patient before issuing a reminder will likely be seen as more polite and less offensive/annoying than one who does not, though this effect will diminish over time as the reminder and the patient become more familiar with each other and their roles. Humans navigate this etiquette largely without being consciously aware of it (though special circumstances, such as the clash of differing cultures and their associated etiquettes, may bring such awareness to the fore); computer-based avatars (as well as non-personified or –embodied agents) must have some formally-encoded knowledge of the expectations and interpretations of various social interaction behaviors.

Relevant social interaction behaviors, even those for different cultures and contexts, can frequently be emulated in hand-written scripts and simple, locally-relevant rules. But such approaches are time- and labor-intensive in their own right and brittle—only limited interaction complexity can be supported if every move has to be hand-scripted in advance. Such an approach might be sufficient for a simple medication reminder, but we are interested in understanding and generalizing the approach to more complex and unpredictable interactions and are using the medication reminding domain as a constrained starting point. A general theory and model of social interactions would greatly enhance the usability and sophistication of avatars, while improving the speed and/or reducing the cost of their construction. Therefore, our focus is to develop general models and methods of achieving and assessing believable social interactions between individuals and small groups. We are looking to leverage existing theoretical work from human-human interactions on what constitutes “appropriate” interaction etiquette to develop a computational model to adapt and/or score the interaction behavior of a computer-based avatar in a given role and with a given action intent.

What Is “Etiquette”

The terms “etiquette” and “politeness” are likely to evoke notions of formal courtesies and which dinner fork to use. But politeness is a technical term in anthropology, sociology and linguistics having to do with the processes by which we determine and manage the “threat” inherent in communication and interaction between two intentional agents in a social interaction—that is, agents that are pre-

sumed to have goals and the potential to take offense at having those goals thwarted in any interaction where those intentional attributes are relevant (cf. Dennet, 1989; Goffman, 1967). As we see below, politeness in this sense is the method by which we signal, interpret, maintain and alter power relationships, familiarity relationships and interpretations of the degree of imposition of an act.

We use the term etiquette to refer to the set of expectations about observable behaviors that allow these interpretations to be made in a cultural context. Observable behaviors are interpreted against a framework of etiquette norms and their associated expectations to allow conclusions about the intentions and character of those we interact with, while simultaneously, we choose behaviors (consciously or unconsciously) on the basis of the same etiquette framework—which dictates how they will be interpreted by those who observe them. As such, the formal and prescriptive etiquettes formulated by Miss Manners and Emily Post are a particularly stilted example of “etiquette” in our more general sense, but hardly the only one; more common are the unwritten (and descriptive) etiquettes we encounter, manipulate and react to as we move through our lives—the etiquettes of the classroom, the locker room, the marketplace, etc. Etiquette refers to the expected “moves” in context that allow participants to make inferences about group membership, power relationships, formality/informality, degree of friendship, importance of information conveyed, etc. Violation of etiquette can convey lack of regard, lack of acceptance of the proposed relationships, or can convey overriding concerns such as a critical threat.

A Model of Human-Human Etiquette for Politeness

A seminal body of work in the sociological and linguistic study of politeness is the cross-cultural studies and resulting model developed by Brown and Levinson (1987). Brown and Levinson were interested in cataloging and accounting for regular deviations, across languages and cultures, from Grice’s (1975) conversational maxims. For example, if I say to you “Please pass the salt,” the “please” in that request is unnecessary for a truthful, relevant or clear expression of my wish and in fact explicitly violates Grice’s Maxim of Quantity (that speech acts should be as brief as possible) since the “please” is not relevant to the content of my expressing a request or desire for salt. So why do I include it? Brown and Levinson collected and catalogued a huge cross linguistic and cross cultural database of such violations of efficient conversation. Their explanation for many of these violations is embodied in their model of politeness.

The Brown and Levinson model assumes that social actors are motivated by a set of wants including two important social wants based on the concept of face (Goffman, 1967) or, loosely, the “positive social value a person effectively claims for himself” (cf. Cassell and Bickmore, 2002,

p. 6). Face can be “saved” or lost, and it can be threatened or conserved in interactions. Brown and Levinson further refine the concept of face into two specific subgoals that all social actors can be presumed to have:

1. *Positive face*—an individual’s desire to be held in high esteem, to have his/her actions and opinions valued, to be approved of by others, etc.
2. *Negative face*—an individual’s desire for autonomy, to have his/her will hold sway, to direct his/her attention where and when desired, etc.

The problem is that virtually all interactions between social agents involve some degree of threat to the participants’ face—what Brown and Levinson call Face Threatening Acts (FTAs). My simple act of speaking to you, regardless of the content of my words, places a demand on your attention that threatens your negative face, for example. This, then, is the reason for the “please” in my request for the salt above: If I simply state my desire that you give me the salt as bald propositional content (e.g., “Give me the salt”) I may efficiently communicate that intent, but I have also been ambiguous about whether or not I have the power or right or can otherwise compel you to give me salt. You might well take offense at the implication that I could demand salt from you, and in this way, I would have threatened at least your negative face and perhaps your positive face as well.

The “please” in the example above is an example of a politeness strategy used to “redress” or mitigate the threat contained in the request for the salt. Furthermore, the expectation that such a strategy be used in certain contexts is an example of etiquette that enables interpretations. The etiquette which we believe to be in play entitles us to conclude that those who use “please” in an appropriate context are striving to play by the rules—striving to be seen as polite; those who do not are not striving to be polite for various reasons (perhaps they don’t believe they need to be, perhaps their notions about politeness are different, perhaps they are just rude.)

The core of Brown and Levinson’s model is the claim that the degree of face threat posed by an act is provided by the function:

$$Wx = D(S,H) + P(H,S) + Rx$$

- Wx is the ‘weightiness’ or severity of the FTA
- $D(S,H)$ is the social distance between the speaker (S) and the hearer (H). Social distance is roughly equivalent to the inverse of familiarity—it decreases with contact and interaction, but may also with be based on a priori factors such as membership in the same family, clan or organization and perhaps on being in a “familiar” setting as opposed to a formal one—a sporting event rather than a church. Social distance is a symmetrical relationship—S and H share the same social distance. In training contexts, social distance might derive from

familial or clan relationships, or it might be used to convey (or invite) a deeper degree of familiarity with a tutor, sidekick or counselor.

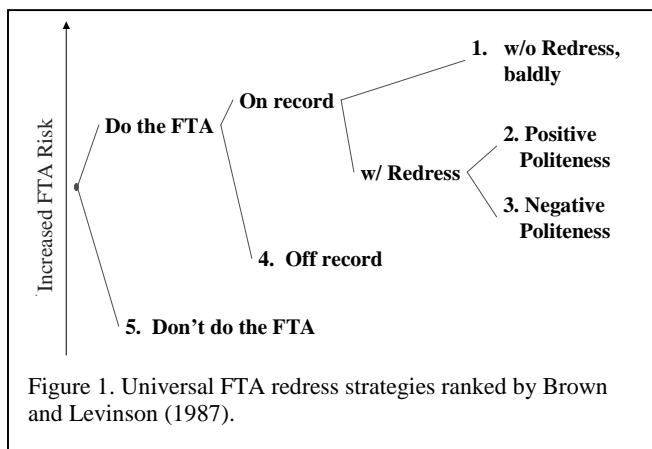
- $P(H,S)$ is the relative power that H has over S, the “degree to which H can impose his/her own plans and own self-evaluation (face) at the expense of S’s plans and self-evaluation” (Brown and Levinson, 1987, p. 77). Power comes from different sources in different cultures and organizations, but power relationships are likely to be of particular importance in medication reminding. Power is an asymmetric relationship between S and H.
- Rx is the ranked imposition of the raw act itself. Some degree of imposition is culturally defined—it may be inherently more of an imposition to request food from a host in Western culture than in an Arabic one, for example. But imposition is also dependent upon the roles and duties of the parties involved. One reason a tutor can correct a pupil (even, say, a royal one), is that the correction is expected from the tutor and is, therefore, less of an imposition.

Brown and Levinson themselves do not operationalize these parameters; instead, they are offered as qualitative constructs. Recent work by Cassell and Bickmore (2002) and by Johnson, et al., (2004) has created numerical representations for them. In Cassell and Bickmore’s work, the resulting computational model was used as a component in a conversational avatar (a real estate agent) whose goal is to use small talk to increase familiarity to the point where a more face threatening conversational topic (such as personal income level) can be introduced. Johnson has used a similar model to create a pedagogical agent that is designed to maintain and enhance learner confidence and motivation, by offering advice and criticism in ways that protect the learner’s face.

Redressing Face Threats

Since FTAs are potentially disruptive to human-human relationships, and since we generally wish to avoid disruption, we make use of redressive strategies to mitigate the degree of face threat imposed by our actions. Brown and Levinson offer an extensive catalogue of universal strategies for redressing, organized according to 5 broad strategies. These are illustrated in Figure 1 ranked from least to most threatening.

- The least threatening approach, obviously, is simply not to do the FTA.
- If one is to do the FTA at all, then the least threatening way to do it is “off record”. Off record FTA strategies are means of doing the act with a sort of “plausible deniability” by means of innuendo and hints. If done successfully, S can accomplish the goals of the act without running the risk of face threat because, after



all, the FTA was never overtly done. An “off record” method of asking for the salt from the example above might be “I find this food a bit bland”. By using this approach, I have not implied that I have any right to demand salt from you, or anyone—in fact, I haven’t even asked for salt.

- If one does FTA overtly, then one can still undercut its degree of threat by offering redress aimed at either positive or negative face. Brown and Levinson suggest that negative redress will be more effective (less threatening) than positive. Johnson, et al. (2004) reports that redress associated with the type of threat is more effective (e.g., negative redress for negative face threat and positive for positive). Negative redressive strategies focus on H’s negative face needs— independence of action and attention. They minimize the impact on H by being direct and simple in making the request, offering apologies and deference, minimizing the magnitude of the imposition and/or explicitly incurring a debt. “I’m sorry, but I’d be very grateful if you could just pass me the salt” includes many negative redress strategies (apology, incurred debt, minimization of the imposition).
- Positive redressive strategies target the hearer’s positive face needs—the desire that his/her needs and wants be seen as desirable. These strategies emphasize common ground between S and H by noticing and attending to H, by invoking in-group identity, by joking and assuming agreement and/or by explicitly offering rewards/promises. “Hey buddy, you want to pass me that salt, don’t you?” is a positive redressive strategy that incorporates both an in-group identity marker and assumed compliance.
- Finally, the most threatening way of performing an FTA is “baldly, on record” and without any form of redress. In some cases where power of S over H is high, familiarity is high and/or imposition is extremely low, doing an FTA with no form of redress may be the expected thing to do. The “Give me the salt” example used above is a bald, unredressed form of performing that FTA.

Brown and Levinson’s model doesn’t stop at that level, however. For positive and negative redressive and off record strategies, they offer a host of well-researched examples from at least three different language/culture groups (English, Tamil and Tzeltal) organized into a structure of mutually supporting and incompatible approaches. We do not have space to present their findings in depth.

In summary, therefore, the sociolinguistic work of Brown and Levinson provides us with a rich universal model of how and why specific acts are seen as polite or impolite, and specific culturally-independent (at least in the sense that they have been abstracted away from the details relevant to a specific culture) strategies for steering the perception of an act toward either politeness or impoliteness. Furthermore, it offers at least the beginnings of a computational and predictive theory of how to generate social interactions that will be perceived as polite (when that is the desired intention) and that may be perceived as less polite (when that is more appropriate). Finally, and of particular importance for medication reminding, it offers the suggestion that when an act is not what was expected by the hearer (H), the hearer may reinterpret what s/he thought they knew about the context—in terms of adjusting the previously understood beliefs about social distance, power relationships and degree of imposition of the act. We believe these parameters may be important in medication reminding when, for example, we may want to raise the degree of perceived impoliteness of a reminder in order to provoke a reinterpretation about the imposition of the reminding act and, therefore, a reinterpretation of the importance, urgency or desirability of taking one’s medicines.

In the remainder of this paper, we will describe some preliminary work we have done to encourage the belief that the Brown and Levinson model can serve as a predictor of perceived politeness in a medication reminder context. Then we will briefly outline another project in which we are developing a computational and predictive framework for perceived politeness in avatar interactions.

Etiquette for I.L.S.A. Medication Reminder Interactions

The Independent LifeStyle Assistant™ (I.L.S.A.) is a Honeywell Laboratories and National Institute of Standards and Technology program to develop innovative, high-potential technology for elder homecare applications that will be integrated, context-aware, adaptive and serve in either an autonomous role, or as an autonomous intermediary between the elder and his or her caregivers (Haigh, Kiff, Meyers and Krichbaum, 2004). Elder home care is, in some ways, a unique and challenging problem for an automated support system since elder activities are extremely varied and unscripted, the user population itself is highly diverse in its skills, capabilities, and in its knowledge and tolerance of technology. Finally, we were seek-

ing a technology that elders could live with “full time” in their home and leisure environments.

One aspect of I.L.S.A. was a medication reminding function which operated by tracking a client’s movements, determining whether or not the client had opened a medicine cabinet or caddy near the time when a medication dosage was expected (according to a previously input medication schedule) and, if not, called the client on his or her telephone and issued recorded message to serve as a medication reminder.

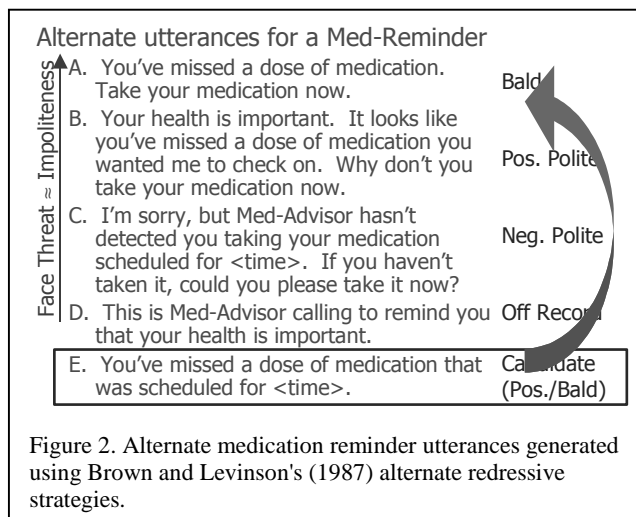
There is increasing evidence that even moderately complex automation evokes “social” responses from humans who use it (Reeves and Nass, 1996). It is, therefore, not hard to believe that these social responses can either enhance or inhibit not just the human experience of interacting with a machine system, but also the overall effectiveness of the human + machine system (e.g., Miller, 2002; Norman, 2002; Parasuraman and Miller, 2004). What is largely missing is data about how to design human-machine interaction “etiquette” so that it evokes appropriate, accurate and effective behaviors, actions and intuitions in human users. In this study, we used the Brown and Levinson model of human-human politeness to guide the design of spoken and textual reminders provided to elderly clients by a medication reminder system. We were not able (due to the timing of our involvement, primarily) to affect the choice of medication reminder utterances used by I.L.S.A., but we performed the following study to examine the perceived politeness of the chosen utterance in terms of the Brown and Levinson model and in contrast to other, potential utterances that the model predicted would be perceived as either more or less polite.

Method

We used the Brown and Levinson model to construct several alternate utterances (with associated predictions for their degree of perceived politeness) for an automated medication reminding system to issue when it detects (perhaps erroneously) that its human “client” has missed a dose of medication. A series of simple questionnaires posed these alternatives to a variety of audiences including: elders familiar with a specific medication reminding system, a baseline population of individuals ranging from 20-50 years of age with no specific familiarity with the system, and the system’s engineers themselves. In all cases, utterances were described as coming from a machine reminding system. Finally, data was gathered by questionnaire, focus group and in-home sensing devices from a small group of elders who used a fielded prototype of the Honeywell I.L.S.A. system with one of the selected reminder utterances for a period of up to 6 months. The alternate utterances are presented in Figure 2.

Utterance E in the figure is the one that I.L.S.A. project engineers intended to use in the field tested system. When we analyzed this utterance using Brown and Levinson’s

catalogue of redressive strategy types, this appeared to be a generally bald utterance with perhaps a hint of positive politeness in its indirect appeal to the patient’s interests by reference to his or her medication schedule. The remaining four utterances (A-D) were created to exemplify Brown and Levinson’s four utterance categories (the fifth, “Don’t do the FTA”, was omitted under the assumption that a medication reminder was necessary and warranted in the circum-



stances). These four are arranged in what Brown and Levinson predict should be an order of increasing perceived politeness. The first, A, is a bald statement of the missed medication dosage and a blunt reminder; it was predicted to be perceived as very impolite. The second, B, was an example of a reminder with positive politeness redressive strategies—appeals to the interests of the patient and presumed compliance. It was expected to be seen as more polite than A, but less than C or D. The third utterance, C, made extensive use of negative politeness redressive strategies such as apologizing, emphasizing the patient’s independence by apologizing and suggesting that the speaker might be mistaken. This utterance was expected to be ranked as more polite than B but less than D. Finally, utterance D is intended as an example of an “off record” request in which the general topic of the client’s health is mentioned, but no specific reminder of missed medication or request to take a dosage is included. Since utterance E was nearly as bald as utterance A but with a bit of positive redress, we hypothesized that it would be regarded as somewhere between utterance A and utterance B in perceived politeness.

Participants in each age group were presented with the full list of utterances in randomized order and were asked to rate both their perceived politeness and their perceived “appropriateness” as a reminder to get them (i.e., the participant) to take their medication.

Results

The results of this simple experiment are presented in Figure 3. Because of the relatively small subject participant pools (N=15 for Engineers and Nominals, N=22 for Elders) and the fact that ranking and not rating data were collected, these results have not been subjected to statistical analysis and are presented here for their qualitative value only.

These results suggest that the rank order predictions from Brown and Levinson's model provide a reasonably

fore, that such utterance types may therefore be difficult or impossible for a machine to accurately produce, or for a human to recognize them when coming from a machine.

Figure 4 shows participants' ratings of the "appropriateness" of each utterance (reversed to provide a common scale with the "impoliteness" ratings above). We used the term "appropriateness" to attempt to get participants to think about the potential differences between a "polite" interaction and one that might be effective in getting them to take their medicines. As can be seen in the figure, elderly respondents did not, as a group, see much difference between the various utterances in terms of their appropriateness.

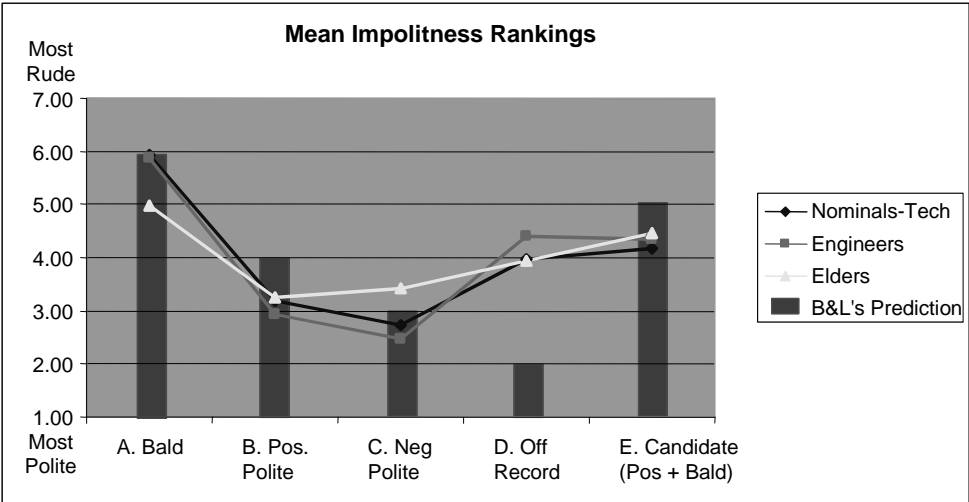


Figure 4. Rankings of perceived politeness.

accurate prediction of perceived politeness for all age groups and for all but one of our utterances – utterance D: “off record”. In human-human conversation, these are intended to be highly indirect (or oblique) and context dependent, providing the speaker with plausible deniability for having made a request at all. We hypothesize, there-

atness, though younger participants followed a similar pattern to each other. As can be seen by comparing the two figures, there were some substantial differences in how participants assigned the two terms. Generally, the off-record strategy (utterance D) was seen as highly “inappropriate” perhaps precisely because it did not make a clear

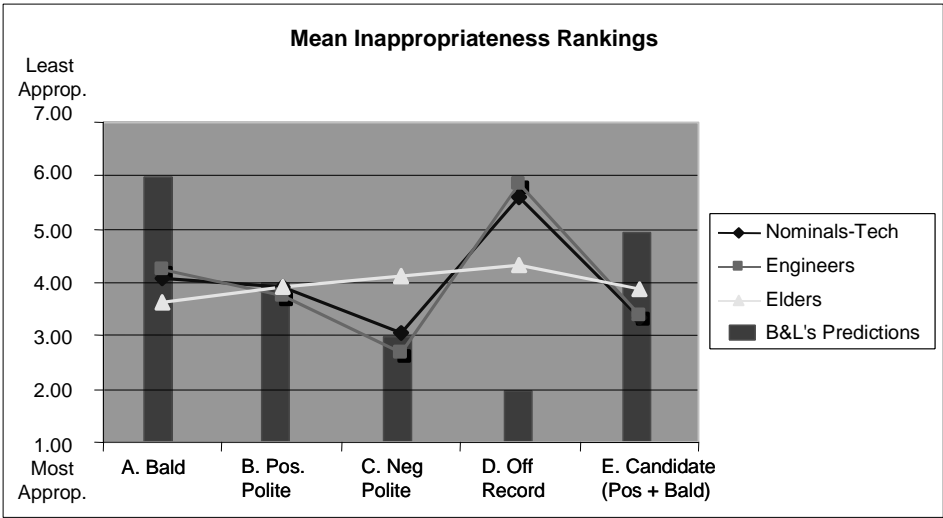


Figure 3. Rankings of perceived appropriateness.

reminder to take a medicine dosage. The most bald utterance (A) was deemed slightly more appropriate than it had been deemed polite. Nevertheless, utterance C (negative politeness) which was expected to be perceived as most polite after the off-record utterance (B) was also seen as the most appropriate here.

I.L.S.A. Field Test and Focus Group Results

In a separate study, the prototype Honeywell I.L.S.A. system was fielded in a total of 11 assisted living apartments in 2 different facilities for time periods ranging from 4 to 6 months. The medication reminder described above (using an utterance similar, but not identical, to E above) was fielded as a part of this system. Although no direct data on medication compliance was collected as a part of this field test, two relevant forms of data to the role of an etiquette-based reminding system were obtained. First, data were collected on the frequency with which reminders were provided throughout each participant's use of the I.L.S.A. system. These data showed that during the initial four weeks of having I.L.S.A. installed, a statistically significant decline in the frequency of reminders over the time period ($p < .01$ in a 2-tailed, pair comparison T-test with $N=9$) from an average of 3.17 per participant per week during the first four weeks that I.L.S.A. was installed to an average of 1.06 per week during the final four weeks.

Since reminders were issued whenever I.L.S.A. "thought" the patient had missed a medication dose within a specified time window, reminders could be either correct (i.e., in response to an actual missed dosage) or incorrect—and we have no ability to clarify which is the case for these data. Thus, while the fact that the incidence of reminders decreased over familiarity with I.L.S.A. necessarily indicates that some adaptation was going on, this might have been due to the patient's adapting to I.L.S.A. or vice versa. In fact, as we will see below, there is some evidence that participants were learning new behaviors designed to avoid receiving the reminders—and that these did not always involve complying with the medication schedule.

These measured data were augmented by two focus group sessions with many of the I.L.S.A. field test participants. Although the full range of I.L.S.A. behaviors were discussed, significant time was spent evaluating the medication reminders. While focus group results were necessarily qualitative and somewhat subjective, they indicate users' reactions to the I.L.S.A. reminding interactions. Participants generally did not like the phone message. Many reported ignoring it (e.g., not answering the phone when they "knew" it was I.L.S.A. calling), while others reported rushing their morning schedules so as to beat the phone call they knew would be coming. Most reported some help in taking their medications (e.g., earlier, more reliably, or through the use of I.L.S.A. as a checking feature). Some specific comments included:

- "I didn't like the phone calls at all! A nuisance"

- "I had to find out a method to 'beat the box'"
- "I hated the voice and tone. Too cold and impersonal, machine-like" [Even though the voice was a recorded human and not machine generated.]
- "I'd start the message with a cheerful 'good morning!'"
- "I would prefer a human"
- "I just pretended not to be home. I would prefer a sound."

The last comment above provoked an interesting discussion in our focus group. The participant quoted above thought that the time involved in answering the phone and listening to a spoken message was overly disruptive and would have preferred a less time consuming tone of some sort. On the other hand, roughly half of the participants indicated that they would prefer more, rather than less, human-like attributes from I.L.S.A. an Discussion and Future Plans

Our anecdotal and focus group data imply that at least some elders are very likely to personify home automation and reminding systems of this sort. Elders are also sometimes (though far from uniformly) less comfortable with advanced technological systems. A polite system may therefore enhance an elder's interaction experience. On the other hand, compliance with reminders might or might not be enhanced more by an impolite (or at least more commanding) one. At any rate, we suspect that the perceived etiquette of the reminding system will be an important variable in its successful design. Nevertheless, we find this to be an extremely understudied topic, especially with regards to elder interaction with technology.

Discussion and Future Plans

The data obtained in this study provide at least initial indications that the Brown and Levinson model of politeness and etiquette in social interactions can predict the perceived politeness of a machine in human-machine interactions. With the possible exception of the off-record strategies, a non-embodied machine that issued medication reminders using various redressive strategies would have those redressive strategies perceived as more or less polite very much in keeping with what Brown and Levinson would have predicted. The focus group data tend to bear this interpretation out: participants who used the I.L.S.A. system with a reminder that was predicted to be seen as moderately rude did, in fact, report perceiving the reminder as rude.

On the other hand, these data also support the interpretation that a purely polite medication reminder may not be the best one for the purposes of medication schedule compliance. Participants generally noted a difference between their "politeness" ratings and their "appropriateness" ratings, and both the objective data from the field test and the

subjective data from the focus group reviews of the I.L.S.A. system suggest that medication schedule compliance did improve with the reminder utterance that was used. Nevertheless, participants clearly did not like this reminder—though some of them said they would have preferred a more polite and/or more personified one, while others would have preferred a less intrusive and less personified one.

Taken together, these results suggest that any politeness- or etiquette-based reminding system, whether embodied in a visible avatar or not, will need to be highly flexible and will need to adapt to its individual user's expectations both initially and over time and contexts. Sterner reminders might well produce better compliance, but they will certainly also produce more resentment and, potentially over time, reduced compliance and/or strategies to "fool" or avoid the reminders. Elders seem to welcome the reminders in general and most admit they are helpful. When a dosage was legitimately forgotten, a reminder was appreciated and, *if they feel it is warranted*, even a certain degree of sternness is welcome.

Providing this degree of sensitivity will not be easy. An adaptive etiquette-based approach will be necessary, and it will need to take not only the patient's expectations, but also his/her recent actions into account as well. We have recently begun work that will provide an important enabling capability for such a system under a Small Business Innovation Research grant from DARPA/DSO. As with the much larger DARWARS program, DARPA's interest is in the ability to create avatars for use in simulations and training games for the purpose of soldier training.

But in addition to the comparatively simple combat simulations that are already in place, DARPA is also interested in providing training in the skills required for "stability operations" and joint operations leadership and cooperation. All of these skills require detailed, accurate and culturally-dependent models of the social interaction behaviors of different simulated individuals from different cultural backgrounds and in different roles.

We are currently developing and evaluating a "believability metric" based on the interaction moves (and their expected etiquette implications) between two actors—either human and avatar or two avatars. This metric will be based on the Brown and Levinson model, but will take the perspective not of the hearer (as is the case in Brown and Levinson), but of an observer who meshes observed etiquette behaviors against those that would have been expected in context. These expectations will necessarily be informed by both the individual's cultural background and understanding of the speaker's culture, and also by prior experiences. This believability metric could ultimately be used to adapt the behavior of an avatar to either exhibit or be sensitive to the expectations of alternate cultures, and to change its behavior in order to shape the interpretations of the hearer.

In the case of a medication reminding avatar, this might mean decreasing the degree of politeness (including extended greetings and explanations) as the number of interactions between the patient and the avatar grows. Alternatively, the degree of politeness might be decreased precisely in order to shape the interpretations of various of the dimensions that Brown and Levinson incorporate. For example, to increase the degree of imposition to indicate that the taking of medication is a serious matter and warrants an increased degree of imposition, or to increase the degree of perceived power of the Speaker (the reminding system) over the Hearer (the patient).

This work is currently in its very initial stages and much work needs to be done yet both to develop and to tune the resulting model. Nevertheless, it seems clear that an explicit model of perceived politeness and the associated etiquette maneuvers which may produce or affect it is required in order to provide the degree of sophistication and sensitivity that medical advising and compliance systems may require. d more than one in our small sample reported implicitly personifying the system they were working with—assuming that it had a personality and intentions.

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Related publications and associated research links on the I.L.S.A. program may be found at the following URL. <http://www.htc.honeywell.com/projects/ilsa>.

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